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IMAGE COMPRESSION

JUNE 1990

ONRA
Interim Report #1

Item 0001AA

Contract #N00014-90-C-0124

SCOPE OF REPORT

This report covers algorithm development and theoretical work performed during the months of May and June.

ALGORITHM DEVELOPMENT

WORK TO PRESENT. During May and June we investigated correlation methods for determining affine iterated function sets. Our basic method is to compare portions of an image with other portions of the same image. The affine transformations which we choose by this process must therefore specify range and domain as well as gray level. Although the compressions we attain by such codes run from 10·1, to 20:1, this method has the advantage of being completely automatic and requiring no pre-processing. Furthermore our image encoding is relatively rapid, requiring approximately 30 minutes for a 256 by 256 image, when the algorithm runs on a Sun 4 computer. We have run the algorithm on 10 separate images. Figures 1. through 4. show the convergence of an IFS on a 256 by 256 image. Root mean square error is about 13.7% for this image. This translates to a signal to noise ratio of 25 to 30 dB. Dr. Yuval Fisher is preparing a paper for publication on this work.

ANTICIPATED WORK. During the next two months we will investigate several potential improvements in the code. These include modifications of the tiling, relaxing conditions on the multiplicity of the mappings (the trade is size of the tiles vs the number of segments mapping into a given tile) and the use of Fourier transform method to improve the choice of affine maps.

THEORETICAL INVESTIGATIONS

WORK TO PRESENT. During May and June we investigated the behavior of generalized Gaussian functions under affine transformations. A generalized Gaussian is given by a function:

$$G(x) = \exp(xAx + bx + c),$$

where x is a vector in the plane, A is a symmetric, negative definite matrix, and b is a fixed vector. The set of generalized Gaussians is preserved under non-singular affine

transformations and the orbits (up to a projective representation) are specified by the cogredience class of A. The objective of this work is to clarify the relationship between image coding by wavelets and image coding by iterated function systems. This work has shown some connections between generalized harmonic analysis and the theory of fractals, in particular through representations of the extended metaplectic representation and the inhomogeneous symplectic group.

ANTICIPATED WORK. During the next two months we will investigate relationships between the Wigner transform, affine transformations, and generalized Gaussians. The objective of this phase of the study is to improve the choice of affine iterated function systems.

STATEMENT "A";TITLE SHOULD BE:"Image Compression" per Dr. M. Schlesinger ONR/Code 1112
TELECON 7/9/90 VG

Figure 1

Figure 2

Figure 3

Figure 4